



National Institute of Standards & Technology

Specifications

Standard Reference Instrument Series 6005

Polymerization Stress Tensometer

Description: The Polymerization Stress Tensometer (PST) is a cantilever-beam based measurement instrument that combines beam deflection mechanics with capacitive sensor technology to measure real-time polymerization shrinkage stress (PS) during the photocuring process for composite resins.

A LabVIEW-based graphical user interface (GUI) developed at NIST is provided with the PST to enable the user to specify the curing mode and irradiation parameters using a light-emitting diode (LED) and light intensity control system. The PST and GUI software are delivered ready for the integration of thermocouple and near-infrared spectrometer; thus, PST/GUI simultaneously provides real-time kinetics data with accuracy and sensitivity on polymerization shrinkage stress, degree of cure, and reaction exotherm. The PST and PST/GUI are interchangeable in this specification.

Design, assembly and technical measurements leading to the production of this SRI were performed by the NIST Biosystems and Biomaterials Division in Gaithersburg, Maryland. Support aspects involved in the issuance of this SRI were coordinated through the NIST Office of Reference Materials.

Specifications: NIST provides the PST as Standard Reference Instrumentation (SRI) with performance that is equivalent to that of NIST systems in terms of mechanical accuracy, provided that operators follow recommended best practices and perform intercomparisons with comparable stress measurement sources. The NIST PST SRI is offered in one standard configuration. The PST cantilever beam with holder and base stand are fabricated and packaged by NIST in accordance with existing and established fabrication protocols. The PST SRI is constructed using commercially available components and includes software that optimizes operator control and produces real-time measurement results.

NIST researchers continue to develop and improve the PST system and measurement techniques. The PST components/systems and associated measurement capabilities are identical to those of NIST systems at the time of acquisition. NIST is providing the PST through the SRI program with prices derived such that NIST is reimbursed for all costs associated with duplicating the current versions of NIST systems. Prices also include support, training, and on-site demonstration.

Anne L. Plant, Chief
Biosystems and Biomaterials Division

Steven J. Choquette
Acting Director Office of Reference Materials
Material Measurement Laboratory

Gaithersburg, MD 20899
Certificate Issue Date: 3 March 2016

Standard Configurations:

- 6005a** The base PST components and systems have the following specifications and features.¹
- A capacitive probe tested and demonstrated to produce stable, measurable voltages over the range from -10 volts to +10 volts over a 2,000 μm measurement distance.
 - Several system components that are commercially available.
 - Operating input current for light intensity control up to a recommended 1000 mA.
 - A NIST-designed custom base stand, stainless steel cantilever beam, electronic and hardware integration components, cables, 2.5mm and 6mm-diameter collets, and X-Y stage controls.
 - Custom LabVIEW software that provides user input control, data acquisition displays, and file saving options.
 - The capability to change the curing light system (LED) installed in the PST.
- 6005b** Includes the PST base model plus a power activator kit to initiate the polymerization process. The power activator kit includes a LED light irradiator for a targeted wavelength and a light intensity controller system.

Delivery: Delivery and installation dates will be determined on a case-by-case basis in coordination with the customer and based on the availability of components and NIST staff.

Shipping: Unless otherwise agreed by the parties, shipping terms shall be [EXW \(Incoterms 2010\)](#). NIST will prepare packaging for shipment of the PST SRI. Shipping crate dimensions and weight will be included in each quote. Customers are responsible for arrangement of shipping pickup at NIST as well as all customs duties and import fees (HTC 9024.80.0000).

Installation: At the customer's location, NIST staff will complete final assembly of the system and perform a system demonstration. Demonstration is defined as follows: Using a commercial dental composite (TPH Spectra™, Dentsply Caulk), the development of polymerization shrinkage stress of a 2.5mm-diameter and 6mm-diameter sample will be shown on the PST.

Training: NIST staff will provide up to 8 hours of in-person training to customer staff on PST operation, maintenance, and measurements.

Support: NIST staff will provide up to 10 hours of technical assistance, consultation and support for a two-year period beginning on the system qualification date.

Technical requirements at installation site: Customers must provide the following:

- A) A Windows-based computer with universal serial bus (USB) ports, sufficient memory for PST software (minimum 1GB RAM, 5.5GB disk space) and a CD-ROM drive for software installation.
- B) Software and licenses for National Instruments LabVIEW Full Development and MathScript RT Module (32-bit version, 2013 or later). Note: MathScript RT Module currently does not support 64-bit LabVIEW software installations.

¹ Certain commercial equipment, instruments or materials are identified in this certificate to adequately specify the experimental procedure. Such identification does not imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the materials or equipment identified are necessarily the best available for the purpose.

- C) Customs related clearances, documents, payments, and fees.
- D) Appropriate power and utilities for the PST components, including earth-grounded power outlets and connectors.
- E) Any replacement commercial instruments and components that are integrated into the PST system other than what is installed by NIST.
- F) Any sample materials, cables, rods, sleeves, LEDs, etc. other than those supplied by NIST at installation.
- G) Spacers for setting the sample height in the PST.
- H) Shielding of the PST from interfering external light sources such as outdoor light, fluorescent light, other instruments, etc.
- I) A level, non-slip, non-conducting surface with sufficient space for installing the PST.
- J) A location for the PST that is not exposed to excessive heat, moisture or vibration.

Users of this SRI should ensure that the Specifications Certificate in their possession is current. This can be accomplished by contacting the Office of Reference Materials: telephone (301) 975-2200; fax (301) 948-3730; e-mail srminfo@nist.gov; or via the Internet at <http://www.nist.gov/sri>.

Polymerization Stress Tensometer (PST) Configurations-SRI 6005

6005 Cantilever beam-based PST

- a. Custom NIST-developed LabVIEW graphical user interface software for PST control
- b. Custom NIST-developed cantilever beam holder, steel beam and 4-legged base stand with collets, collet closers, hex screws and X-Y stage adjustment knobs
- c. Lion Precision CPL190 linear driver with $\pm 10V$ sensitivity range and capacitive probe with shielded cable, power supply, BNC to alligator clip, and banana plug to alligator clip
- d. Custom NIST-developed metal target with locking nut for voltage measurements
- e. Analog to Digital Converter - Measurement Computing USB 2404-10 24-bit DAQ with $\pm 10V$ range, USB cable and device driver software on compact disk
- f. Arroyo Instruments 6340 ComboSource laser diode and temperature controller with device driver software on compact disk
- g. Arroyo Instruments 226 TEC LED LaserMount
- h. Omega Super MCJ thermocouple-to-analog converter with male SMP plug
- i. Physitemp IT-23 Type-T 0.003" twisted pair thermocouple implantable probe
- j. LED Engin LZ1-10DB00 blue dental high power light-emitting diode